Modeling: Real Life Scenarios for Beach/Dune Vulnerability

Overview: After students complete the Beaches in Motion – Coastal Vulnerability classroom and field trip lessons and activities, this modeling activity will assess students' ability to apply their new knowledge to real life scenarios.

Duration: 45 minutes

NGSS Learning Standard: Science and Engineering Practices**-** Improve skills in developing and using models.

Student Goals: Students will use models to demonstrate their understanding of coastal processes that affect barrier beach ecosystems, and beaches backed by cliffs.

Background:
Cape Cod's sediment is loose till that is easily eroded. Sea level has been rising since the last ice age and George's Bank no longer protects parts of the Cape from powerful storm generated waves due to its submergence from sea level rise. Storms that form over the ocean, like hurricanes, are predicted to increase in intensity and frequency. Low lying barrier beaches are vulnerable to storm wave and wind damage.

Materials- for each team of students and one set of materials for the teacher demonstration.

- 1 tray (approximately 13 inches x 18 inches x 3-4 inches high
- 3-4 cups sand, some pebbles for the *Beaches are Narrowing* scenario
- small amount of wrack material
- blue paper (represents ocean) and green paper (represents salt marsh)
- Copy of beach/dunes/marsh organisms for students to cut out and use in model. This is on page 5 of this document
- Scissors
- **DO NOT USE WATER!,** Have students simulate erosion. using their hands.

What to do and How to Do It:

- Complete the Beaches in Motion Lesson – both classroom and field trips. Completion of these lessons will provide students the knowledge required to do this activity.
- Print two copies of this document. Keep one for reference; the other copy is to cut so each team of students receives one scenario. Use four or five of the eight scenarios that best fit the interests and experiences of the class.
- Teacher should demonstrate the building of the models and a scenario presentation to class.
- Give each team of students their materials: tray, 3 cups of sand, blue paper to represent the ocean, green paper to represent the salt marsh, a small amount of wrack material, and a copy of beach/salt marsh organisms to use in their scenario. Each team needs to read their scenario to know if they should build a barrier beach or a beach with a cliff behind it.
- Give a 15 minutes time limit to complete the model.

- Then have teams read their scenario to the class and explain use their model to demonstrate their given scenario (about 5 minutes for each team.)

Teachers- pick 4 or 5 scenarios that best fit your students experiences or allow for more class time if you decide to do extra scenarios so all teams have time to demonstrate their model.

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Asphalt Parking Lot (build a barrier beach with an asphalt parking lot behind the dune)
Issue: There is an asphalt parking lot built directly behind the dune on the barrier beach. Sea level is rising. Build a parking lot between the dune and the salt marsh. Demonstrate what will happen to the beach, dune, parking lot, and salt marsh as sea level rises and a hurricane occurs.

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People walking over the dunes (build a barrier beach)
Issue: People are walking over the dunes killing the dune vegetation. Place dunes plants and animals on your dune. Then demonstrate the response of the plants and dunes to this foot traffic after high winds and an ocean storm occurs.

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People drive 4-wheel drive vehicles on the beach (build a barrier beach)
Issue: Four wheel drive vehicles drive over the wrack line and damage pioneer plants growing on the back of the beach berm. The wrack materials and plants are important because they catch sand and build dunes. Place wrack materials on the beach and the plants on the backshore of the berm. Demonstrate what happens when no vehicles damage the wrack and plants, and then demonstrate what happens after the wrack and plants are damaged by vehicles. You do not need to talk about piping plovers as another group is demonstrating that scenario.

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Endangered Species Populations Living on Beaches/Dunes (build a barrier beach)
Issue: Piping plovers prefer to nest in beach/dune areas with little slope. Use your model to demonstrate a good nesting site for piping plovers then explain what will happen to the nesting and feeding areas if sea level rises and an ocean storms occur. Discuss that adult and baby plovers feed on invertebrates that live in the beach sand and at the tide lines on both the ocean and marsh sides of the barrier beach. Discuss what will happen to the nests and the chicks that can't fly until they are 28-30 days old after a strong coastal storm. What will happen to their food choices if the dune overwashes and buries the edge of the salt marsh where lots of invertebrates live?

Native American Archeological Site Exposed in Cliff or Dune (build a barrier beach)
Issue: A potentially important archeological site was exposed as the dunes were eroded by storm waves and wind. Build a barrier beach with an archeological site on the ocean side of the dune. Be ready to explain what you would do to save the site after being told a powerful winter nor'easter will occur in five days? Demonstrate how you might save the site and describe how long your actions will be effective. Also, discuss if your actions will cause harm to the beach in another location?

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Coastal Vulnerability (build a barrier beach)
Issue: Low elevations, gentle slopes, and loose sandy sediment on barrier beaches are easily damaged by storms. Build your model to show the ocean, the sand bars, the beach, the dunes, and the marsh. Be prepared to demonstrate what happens to the shape of the beach/dune/salt marsh system and briefly discuss its impact on salt marsh organisms and food chains. Demonstrate a dune overwash, and an overwash fan deposited in the marsh. Discuss impacts to animals that live on the beach/dunes.

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The Beaches are Narrowing- no place to walk even at high tide (build a beach with a cliff behind it)
Issue: Build a beach that is cliff backed rather than a barrier beach. Put one or more houses on the land at the cliff top. Now build a "revetment wall." Revetment walls are made of rocks; they cover the cliff to keep the sand in the cliff from being eroded by waves. Be ready to demonstrate how rock walls and other hard man-made structures cause even more erosion and interfere with the "sand budget." If all the cliffs had walls, then there would be no source of new sand to replace sand moved away by waves and wind. This would cause beaches to narrow and or disappear.

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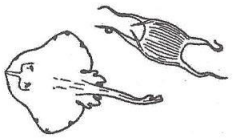
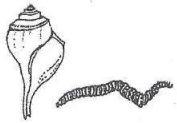
Historic Structure Threatened by Erosion (build a beach backed by a cliff, a Coast Guard Station sits 75 feet back from the edge of the cliff)
Issue: A Coast Guard Station sits 75 feet from the edge of the coastal bank/cliff. At least 50 feet of land needs to be left in front of the building for workmen and their equipment to safely lift the building so it can be moved to another location. The current average rate of erosion is 5 feet/year at this location.

Build the Coast Guard Station in your model. Demonstrate the eroding cliff - Discuss how many years workers might have to move the building before the 50 feet of land safety limit is reached? Discuss and demonstrate what might happen if a super hurricane occurs and 20 feet of land is lost on one storm?

Discuss where can you move the building? Who needs to own the land the building will be moved to? How much do you think it will cost? Or should we let nature take it away?

Student Assessment: Accurate use of terminology, outcome of scenario is realistic



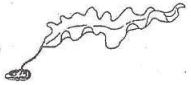


Channeled Whelk and Egg Case
(Busycon cana/leu/atum)

Knobbed Whelk
(Busycon carica)

Beach Flea or Sand Hopper
(Amerlehorchestla sp.)

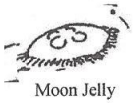
Eelgrass
(Zostera *matinal*



Kelp
(Lamlnaria
agardhi/)

Green Fleece
(Cod/um fragile)

Exploring Sandy Beaches and Dunes

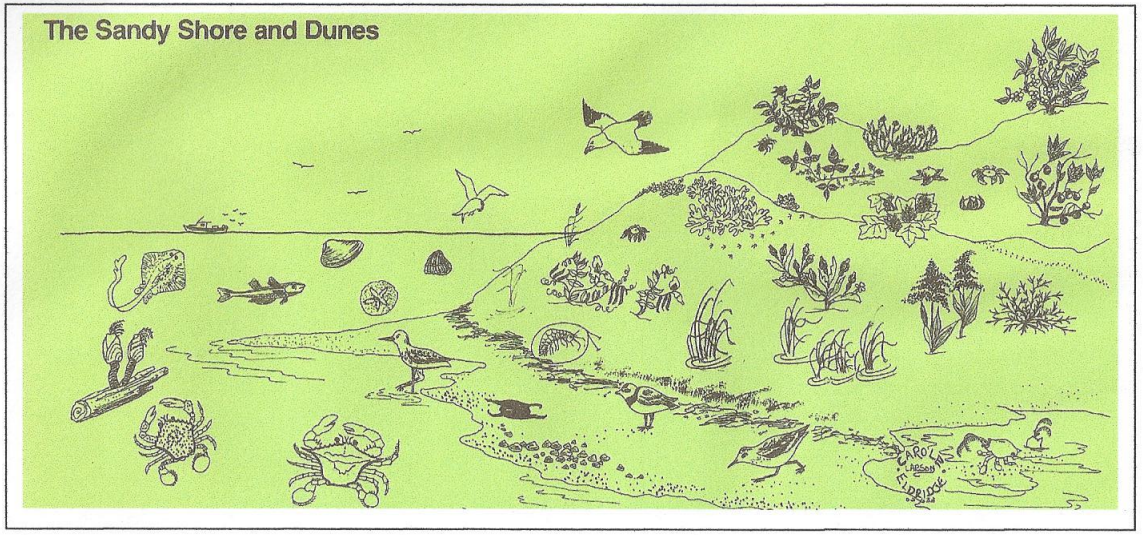


Moon Jelly

Name_____ Date_____

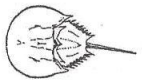
Location_____ Weather_____

Carefully observe the wrackline and dune plants. Circle plants and animals you find or see. Add others on the back.

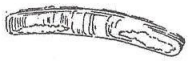


Atlantic Surfclam
(Spisu/a sorldlsslma)

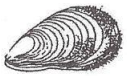
Common Slipper Shell
(Crepldu/a fomlcata)



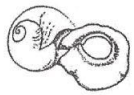
Atlantic Horseshoe Crab (molt)
(Limulus polyphemus)



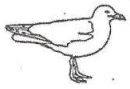
AUantic Razor Clam
(Ensls directus)



Shell of Horse Mussel
(Modiolus modiolus)



Moon Snail and
egg "collar"



Herring Gull
(Larus argentatus)

Dusty Miller
(Artemisia *stelleriana)*

Poison.1vy
(Rhus radlcanS)

Goldenrod
(Solidago sp.)

Bayberry
(Myrica
pensylvanfca)

Seaside Rose
(Rosa rugosa)

American Beach Grass
(Ammophlla sp.)

Smooth Sumac
(Rhus glabra)